THE EFFECTS OF DIFFERENT PERCENTAGES OF KENAF OM THE MECHANICAL PROPERTIES OF ADOBE

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B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

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Thesis submitted in fulfilment of the requirements

for the award of the

Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JANUARY 2019

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Date : 14 January 2019

ACKNOWLEDGEMENTS

First and foremost, praises be to Allah, the Almighty, who has given me the strength to complete this final year project as a requirement for graduation and successful award of the Bachelor's Degree (Hons.) Civil Engineering from University Malaysia Pahang (UMP).

Secondly, I would like to thank a number of people, to whom I am greatly indebted. Without them, this research might not have been successfully accomplished. I wish to express my gratitude to my supervisor, Dr. Fadzil Bin Mat Yahaya for his hard work and guidance throughout this study. Thank you for believing in my abilities and for giving me the foundation to explore further in this area. I would also like to thank to technical member staffs of Civil Engineering Concrete Laboratory UMP for helping and guiding me during conducting the lab tests.

To my family members who have always been supporting me through thick and thin, no words can describe how grateful I am to be a part of my family. Thank you for all the support and prayers, which have helped me to remain strong and focused for completing this research.

Lastly, to all my friends, thank you for those who helped me directly or indirectly, both in my study and in my personal life. I wish you all the best in your future.

ABSTRACT

Soil is the oldest and largest source of structures on since long time, Statistics show that about nearly 30% of the Earths still inhabitants live in mud buildings, particularly in rural areas and cities located in the ancient archaeological plains and valleys surrounded by vast plains, 50% represents a civilized nation. Earth climatic economic environment-friendly is used in a broad and large-scale construction around the world, especially in those countries that not possess large plant life on its territory. The use of the soil before ten thousand years as a major source for the building, along with stones and still some of the remnant of those buildings found until now. In this study, adobe with different proportions of Kenaf. Meanwhile, the control is pure adobe which does not have Kenaf. In addition, different proportions of Kenaf are 0.25%0.5% and 0.75%. There are two types of tests conducted, compressive strength test and flexural strength test. All the specimens were 7 days in air then 7 days in Ventilated Oven with T= 40 C.

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LIST OF ABBRREVIATIONS

BS	British Standard
ASTM	American Standard Test Method
POC	Ordinary Portland cement
RAC	Recycled Aggregate Concrete
RC	Reinforced Concrete

LIST OF SYMBOLS

N/mm2	Newton per millimeter square
KN	Kilonewton
N	Newton
mm	Millimeter
m	Meter
MPa	Megapascal
Kg	Kilogram

CHAPTER 1

1.1 INTRODUCTION

Earth is one of the oldest and most widespread construction materials. It is estimated that approximately 30% of world population lives in earth buildings, and that about 50% of developing countries population, including the majority of rural population and at least 20% of urban and marginal urban population, lives in earth buildings [1].

Adobe can be found in several types of construction: rural and urban buildings, many of which are still in use, walls for the delimitation of properties, water wells, churches and warehouses. Many of the urban adobe buildings present cultural, historical and architectonic recognized value, as for example the buildings of the “Art Nouveau” style.

The success of adobe construction in Aveiro district was principally a result of the characteristics of the existing available raw materials. The main applied raw materials were coarse sand, argillaceous earth and lime. Adobe also can be successful by using natural earth mixtures which were corrected by the addition of clay, sand and lime, and it was also common the addition of fibers (kenaf, for example). By this way, we can control cracking while adobes were drying in the sun. Adobe is a construction material that presents several attractive characteristics. It is low cost, locally available, and recyclable, adapted to a large variety of soils, presents good thermal and acoustic properties, and is associated to simple constructive methods that require reduced energy consumption [7]. Adobe construction, however, if not properly designed and strengthened, may present a deficient response when subjected to seismic actions, suffering severe structural damage and often reaching collapse, as observed in recent earthquakes [8,9]. This problem can be

overcome by adding fibers such as kenaf with limestone to adobe bricks which both have great potential to be used as construction material.

Limestone has the capacity to stabilize clayey soils through pozzolanic reaction. This reaction produces stable calcium silicate hydrates and calcium aluminate hydrates as the calcium from the lime reacts with the aluminates and silicates solubilized from the clay. It provides an economical way of soil stabilization. Lime modification describes an increase in strength brought by cation exchange capacity rather than cementing effect brought by pozzolanic reaction. In soil modification, as clay particles flocculates, transforms natural plate like clays particles into needle like interlocking metalline structures. Clay soils turn drier and less susceptible to water content changes. Lime stabilization may refer to pozzolanic reaction in which pozzolana materials reacts with lime in presence of water to produce cementitious compounds. The effect can be brought by either quicklime, CaO or hydrated lime, Ca (OH) 2. Slurry lime also can be used in dry soils conditions where water may be required to achieve effective compaction. Quicklime is the most commonly used lime; the followings are the advantages of quicklime over hydrated lime.

Kenaf is comparatively commercially available and economically cheap amongst other natural fiber reinforcing material. Customarily kenaf denoted as industrial kenaf due to of its great interest for the production of industrial raw materials. Kenaf is wild dicotyledons plant of subtropical and tropical parts of Africa and Asia. The word kenaf is of Persian origin explaining the plant having short day, warm season and annually herbaceous plant, with the average diameter of fiber is 67.6 μm [19]. Kenaf is a hardy, strong and tough plant with a fibrous stalk, resistant to insect damage and requires relatively fewer amount of or no pesticides [20]. Kenaf is compliant to several types of soils and to grow effectively, need only nominal chemical treatment, characteristically some fertilizer and a single herbicide treatment [20]. The three types of fiber: bast, core, and pith constitutes the kenaf plant [21].

In this study, Kenaf and Limestone will be used to make adobe brick. Kenaf fibres receive much attention owing to its prospective probability as polymer reinforcements in

the natural fibre composite industry. Thus, mixing kenaf and limestone with a specific proportions would produce a strong stability for the adobe brick. Therefore, it is necessary to provide the information based on the laboratory and field education of the locally available materials particularly the limestone and the kenaf fiber for a great potential adobe uses.

1.2 Problem statement

Adobe structures are commonly used for conventional residential construction in developing countries, and for construction in rural and remote areas in some developed countries. They are considered sustainable structures and carry high traditional value. However, unreinforced adobe structures are relatively weak when subject to settlement and lateral load, and are quite vulnerable to cracking and brittle failure as shown in Figure 1.

Figure 1 – Cracking failure of Adobe Wall

Illampas et al. (2014), Varum et al. (2014) and Vint & Neumann (2005) have performed vulnerability assessment of unreinforced adobe houses in their research [1-3]. The applicable experimental work involved static tilt testing on house modules, displacement-controlled cyclic tests on I-shaped adobe walls as well as shake table tests on single story model buildings. In all these cases, the response associated with the unreinforced model buildings was compared with those reinforced by cane rods, geogrids, limestone, steel wire, fiber such as kenaf-reinforced polymer strips, tire straps, etc. It was shown that the

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